

Welcome back to Computing with the Cranmer Abacus. This is Lore again. Today in Lesson 2, I'm going to begin with a short review from our initial lesson, then answer the challenge question. After this, we'll be using the abacus for addition work. Ready?

OK, remember, the Cranmer abacus has been designed for blind users. It has a felt backing behind the columns of beads that keep the beads in the place where the user sets them.

There are thirteen columns of beads. Each column contains 5 beads, with a separation bar near the top separating one of the beads from the other four. The bead above the separation bar in each column represents 5 (which I will call the 'sky' bead), and each of the beads below the bar represent 1 (which I will refer to as the 'earth' beads).

Place value on the abacus is read from right to left, with the column farthest to the right being the ones place, then the tens, then the hundreds. You'll notice a small raised mark between the 3rd and 4th columns, this corresponds to a comma when writing.

To set a number such as 548 on the abacus, begin in the 3rd column from the right, that is the hundreds place. Set 5 by moving the sky bead toward the separation bar; in the tens column, move (or set) four earth beads up toward the separation bar; in the ones column, move the sky bead down and three earth beads up to the separation bar. To clear the number, reverse the process and move the beads in each column back up to the sky (for the sky beads), or down toward the earth (for the earth beads).

So, now that we've reviewed setting numbers, here's the answer to last lesson's challenge: What is the largest number you can set on the abacus? To find the answer, first set all the beads in each column toward the separation bar. This means that you will have a 9 set in each column, and the largest place value (the first column from the left) is the trillions place. So, the number is 9 trillion, 999 billion, 999 million, 999 thousand, 999! WOW; perhaps you'll never need such a big number, but isn't it nice to know that you can use the abacus for large number computation?

All right, now we're going to start adding using the counting method. To use this method, let me just introduce you to two "secrets" you'll hear me use quite often. The first is "set-clear", and the second is "clear, set one left". Let's start adding. First, set one: this means set one earth bead in the one's column. Now, we're going to add one more by setting another earth bead, that's $1+1 = 2$. Let's add one more, making three, and one more, that equals 4. Now, we've used up all of the earth beads, so to add one more, we'll need to "set clear". This means set the sky bead down, and clear all the earth

beads. You should now have 5. Continue by adding one earth bead to the sky bead, $5+1 = 6$, $6+1 = 7$, $7+1 = 8$, $8+1 = 9$. Now we've used all of the beads in the one's column, so to solve $9+1$, we'll use the other "secret", "clear, set one left". This means clear all of the beads in the one's column and set one earth bead to the left (in other words, the ten's column). That's basically all there is to the counting method. Now, let's add some two digit numbers.

You may want to write them down on paper first, to refer to, but I'll show you how I set the problem on the abacus.

$$25+24$$

In the second column from the right (that's the tens column), set 2; in the first column on the right, set 5. There's your first number: 25.

In the farthest column on the left set 2, in the next to the farthest column, set 4. That's your second number. Now, you have the problem set on you abacus, and don't need to worry about remembering it. Now, here's one of the BIG differences between adding on paper and adding on the abacus.

When adding on the abacus, you always start with the largest digit. So, you're going to add $2+2$ (2 tens plus 2 tens). On the right you already have 2 tens set, just add on two more earth beads. Now, add $5+4$ by setting 4 earth beads to the one's column, where the 5 is set. You should now have 49, or 4 earth beads in your tens column, one sky bead and 4 earth beads in your one's column. That's the sum of $25+24$.

Let's try another one. Now, you'll need one of those secrets I taught you.

$$403+253$$

Set 4 in the hundreds column, leave the tens column empty, and set 3 in the ones column. Go to the farthest column to the left to set 253. Now, remember to add the largest place value first, which is the hundreds. To the 4 you are going to count on 1, but you've already used all the earth beads, so you need that secret "set-clear", which means set the sky bead down, and clear all the earth beads. Then to finish adding 2 hundreds, set one more earth bead (you should now have a sky bead and an earth bead in the hundreds column). In the tens column, you can count on one earth bead, then another, and another, until you have 4 earth beads, then use the secret again (set clear) to have the five you needed to add. Finally, in the ones column, add 3 by adding 1 earth bead, then use the secret "set clear", then continue counting on to get to three. You should now have 6 in the hundreds column, 5 in the tens column and 6 in the ones column, so your final answer is 656.

Whew, are you still with me? It sounds like a lot of steps, but as you practice, you'll become faster. Go ahead and clear your numbers.

Let's now try a problem using the other secret. Let's try $656+283$.

Set 656 in the hundreds, tens and ones columns, then set 283 on the left. Now, in the hundreds column, count on 1 earth bead to make 7, another 1 to make 8. In the tens column, count on 1 earth bead to make 6, then continue counting on ... 2 (7), 3 (8), 4 (9). Now to continue counting on 5, you'll need the secret 'clear, set one left' (clear all in the tens column, set one bead to the left (the hundreds column). Resume counting on beads in the tens column, this will be 6, one more (7) and one more (8). You should now have 9 in the hundreds column and 3 in the tens column. Finally, in the ones/units column, count on 3 more beads, making a total of 9 beads. So, your sum should be 939.

Well, that was a lot to give you in one lesson. But, all that we've practiced can now be used to add larger and larger numbers. The process is the same. To summarize, when adding numbers on the abacus, use the counting method. The counting method involves adding one bead at a time in the appropriate place value. Two "secrets" will help: set-clear (which means set the sky bead and clear the earth beads), and clear, set 1 left (which means clear the sky and earth beads from the column and set 1 earth bead on the column to the left).

Here are a few problems to try practicing with; you will need to use secrets for some of them:

1. $67+22$
2. $18+33$
3. $43+22$
4. $231+513$
5. $351+104$
6. $725+236$
7. $999+111$

I hope you've found this helpful. Please feel free to give me some feedback on my lessons so far by emailing me at lschindler@mac.com. Check back soon for Lesson 3, when I'll be talking about adding numbers with decimals, as well as presenting some beginning subtraction. Until then, enjoy practicing!